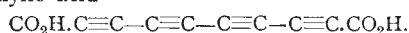


wearied with indigo that he was quite unable to continue experimenting on the subject, and had to allow the various problems connected with the commercial development of his discoveries to pass into other hands. In search of fresh fields for investigation, Baeyer commenced an inquiry with the object of discovering whether carbon atoms, uncombined with hydrogen, are capable of uniting to form long chains, and, in order to determine this, he synthesised a number of poly-acetylene compounds, including tetracetylenedicarboxylic acid



This remarkable acid is quite colourless, but is readily blackened by the action of light, and compounds of this type were found to be so explosive that their further investigation had to be abandoned. One of the fruits of the consideration of the properties of these compounds was the enunciation of the well-known "Spannung's Theorie," which has given rise to so much discussion, and proved to be of such value in suggesting new lines for experimental inquiry.

Section viii., which Baeyer has placed directly after the phthaleins, deals with the chemistry of the hydroaromatic compounds and the constitution of benzol. These researches date from the year 1866, when, in conjunction with Graebe, Born, Mohs and others, he first investigated the behaviour of phthalic acid and terephthalic acid towards sodium amalgam.

Baeyer repeatedly returned to this subject in later years, but it was not until 1888 that the epoch-making series of papers "Ueber die Constitution des Benzols" began with the exhaustive study of the products which are formed when terephthalic acid is reduced with sodium amalgam. These researches on the reduction products of the phthalic acids and of benzene itself are well known, but they have perhaps hardly received the close attention which they merit, owing partly, no doubt, to their difficult and intricate nature. The careful study of these papers will, however, more than repay the time spent, and to the young investigator they may well serve as an example of the patience and endurance which he must be prepared to face if he wishes to attempt the solution of a problem of really first-rate importance.

It is perhaps a consequence of the study of these artificially prepared reduction derivatives of benzene that Baeyer was led to investigate that wonderful series of naturally occurring reduced benzene derivatives—the terpenes—the constitution of which has offered one of the most difficult problems to the modern organic chemist. During the course of his experiments on the oxidation of substances which, like the terpenes, contain unsaturated closed chains, Baeyer commenced to experiment with Caro's acid, and, among many other interesting results, showed that this acid was a most valuable reagent for the conversion of ketones into lactones. Further experiments resulted in the discovery of the remarkable series of peroxidised substances of which benzoyl-hyperoxide and diethylperoxide may be taken as types, and led to a development of Collie and Tickle's important work on the tetravalent nature of oxygen and the oxonium theory.

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Baeyer's latest publications deal with the vexed question of the relation of colour to constitution, and are concerned especially with the reason for the coloured nature of certain salts derived from dibenzalacetone and from triphenylcarbinol. One of the most remarkable results of this investigation is the proof that the coloured salts of triphenylcarbinol are in reality esters possessing the properties of salts, and that they cannot be regarded as quinoid compounds.

Baeyer is, at the present time, occupied with the further development of this important matter.

It is impossible to close the volumes before us without marvelling at the immense amount of work which it is possible for one man to carry out, and without a deep impression of the enormous influence which the work of Baeyer has had on the development of modern chemistry. The list of papers published from Baeyer's laboratory occupies no less than sixty-three pages of closely-printed matter, and when we look at the names attached to these papers we are able to form some idea of the magnitude of the school which he has founded, and of the extent to which many of the greatest chemists of the day owe their training in research to Baeyer.

W. H. PERKIN, JUN.

#### A STANDARD TREATISE ON ELASTICITY.

*A Treatise on the Mathematical Theory of Elasticity.*

By A. E. H. Love. Second edition. Pp. xviii+552. (Cambridge: University Press, 1906.) Price 18s. net.

INSTEAD of merely revising his former treatise, Prof. Love has written a new one; the result is that we have two works by the same author, in some ways contrasting, in others complementary. And as in the similar cases of Maxwell's "Electricity," and Thomson and Tait's "Natural Philosophy," the prudent will buy the new book without parting with the old.

Naturally one feature in the new edition is the inclusion of important or interesting results obtained since the appearance of the earlier one. In some branches of mathematics the proportion of English workers is distressingly small; but in elasticity this is happily not the case, and the recent researches of Michell, Filon, Dougall, and others, besides those of veterans that need not be named, receive in these pages their due recognition. So also do those of their Continental *confrères*, more particularly Voigt; but it is hard to avoid the impression that the deaths of Kirchhoff and Hertz have left vacancies which have yet to be worthily filled.

It is interesting to compare the historical introduction in its old form with its successor. The former was in some places controversial, and the author seems to have thought some of the statements too dogmatic, at any rate in form. However this may be, the new introduction is strictly impersonal, and shows clearly enough how recent physical theories and discoveries affect the subject of elasticity. A great deal of the polemic about the number of elastic constants was as illogical as the quarrel about *vis viva*. As an abstract

mathematical theory, the 21-constant hypothesis is as legitimate as its rival and conversely; the question that interests physicists is which of the two, if either, best corresponds to the properties of elastic bodies. Saint-Venant rightly argued that this could not be settled *a priori*, but only by experiment; and at the present day his justification on this point is complete, although he was led to adopt the rari-constant theory by relying upon inconclusive experiments. As Prof. Love points out (pp. 14, 15) our views of the ultimate structure of matter are being profoundly modified, and until they are cleared up it is premature to propose an "atomic" theory of elasticity. Meanwhile we can make a working hypothesis by assuming the existence of a strain-energy-function which is a quadratic function of the components of strain. In all probability the ultimate theory, if we could only reach it, is kinematical; the stresses set up in a strained body being an aspect of a new distribution of kinetic energy in space.

The results of the theory, as applied to the arts, are, of necessity, only approximate; and great care must be taken to see that, when an approximate solution has been obtained, it is really applicable to the concrete case. An excellent example is given on p. 140, relating to a sphere strained by its own gravitation. If we put in the numerical values of  $g$ ,  $r_0$ ,  $\rho$ , and any reasonable values for  $\lambda$ ,  $\mu$ , when the sphere in question is the earth, we find that the condition that  $U/r$  should be small for  $r_0 > r > 0$  cannot be satisfied, although this is one of the assumptions on which  $U$  has been calculated. This point was brought out in the previous edition (i. 220); it is a pity that this warning has been suppressed, though another, equally instructive, has been given.

Again, take the condition (or conditions) for rupture taking place (pp. 117 *sqq.*). This cannot be given by the ordinary theory, which is only applicable when the elastic limit is not exceeded. Nevertheless, attempts have been made to express the condition in terms of the components of stress. This is entirely illogical, and hence, as usual, a contest between rival formulæ. It may, of course, happen that one formula, as against the other, may have a wider range of applicability; but it ought to be treated as purely empirical, and not rashly applied to untested cases. On this point the author might have been more dogmatic than he is.

A very interesting section is that on the deformation of plates. This is a famous problem, historically, and even lately gave rise to a controversy, now satisfactorily settled. To get a reasonably simple approximate solution some kinematical assumption must be made, and this must be compatible with the boundary conditions. Prof. Love pointed out that, strictly speaking, a vibrating plate with free edges cannot satisfy the condition that the middle surface is unstretched; Mr. Basset and Prof. Lamb showed that the boundary condition could be satisfied without supposing any considerable stretching except near the edge. An interesting statical illustration due to Lamb is given on p. 521. On p. 506 Prof. Love obtains, by a method of his own, second approximations for

stress and strain in a curved shell, agreeing to that order with results of Mr. Basset's.

In this, as in other parts of the book, the analysis is very elegant, and is given in sufficient detail for really competent readers to follow. But the author follows the general tendency now in vogue, of suppressing details of calculation, and emphasising results of practical value, rather than examples of mainly æsthetic interest. In his preface he expresses a hope that his book will be useful to engineers; how far they do so depends, of course, upon them as well as upon him. They will find among the subjects treated the buckling of plates, the collapse of boiler-flues, the whirling of shafts, the stability of slender columns, and other such things; it is to be hoped that they will also appreciate the general theory, as the author presents it. Every student, not an expert, should follow the advice given in the preface of proceeding to chapter v. as soon as possible.

It is a great advantage that the author of this book is a mathematician of wide as well as accurate attainments. As an illustration, it will be enough to refer to p. 306, dealing with the torsion of a rectangular prism; it is at once clear that the author's knowledge of Fourier expansions is quite different from that of the average physicist. Similar examples of rigour free from pedantry may be found throughout the volume.

At the end of the introduction occurs the sentence: "Most of the men by whose researches it [the mathematical theory of elasticity] has been founded and shaped have been more interested in Natural Philosophy than in material progress, in trying to understand the world than in trying to make it more comfortable." It may be added that most of the comfort we enjoy, and most of our civilisation that is worthy of the name, is due to men who have endured discomfort, in pursuance of ideal ends. Apart from the poets and the philosophers, where should we be?

G. B. M.

#### PROTEID CHEMISTRY.

*Chemistry of the Proteids.* By Dr. Gustav Mann. Based on Prof. Otto Cohnheim's "Chemie der Eiweisskörper." Pp. xviii+606. (London: Macmillan and Co., Ltd.; New York: The Macmillan Co., 1906.) Price 15s. net.

DR. GUSTAV MANN started this work with the modest idea of producing an English translation of Prof. O. Cohnheim's well-known monograph on the chemistry of the albuminous substances. But it has developed into a volume of a much more ambitious nature, and has culminated in a book twice the size of that on which it is founded. The subject in many parts is treated much more fully, and a good deal of new matter introduced. In many places, moreover, Cohnheim's own views are adversely criticised, so that the present volume bears witness to the originality of the English author.

Those who know Dr. Mann best as a histologist may be surprised that he should have the necessary knowledge to write on a subject at first sight so far